CONSUMER ENERGY CONSERVATION POLICY:

AN ANALYTIC APPROACH

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The recent decline in the demand for energy has allowed Western industrialized nations some leeway in their plans for reducing their dependency on OPEC for oil supplies. Although it is not clear what portion of the energy decline can be attributed to conservation as opposed to the world wide recession, the opportunity exists for planning and implementing sound conservation programs to ensure long-term economic stability.

The objective of this paper is to provide an analytical model for achieving efficient and effective consumer conservation policies and resultant conservation programs. While the model is based on work conducted for the Canadian federal government, it is believed to be applicable to most Western industrialized nations. The model, described within a consumer energy policy framework, is built on five key constructs.

Component definition: which assists in translating a complex series of independent decisions into a coherent and consistent set of directions.

Assessment criteria: which aids in establishing policy priorities.

Payoff matrix analysis: which identifies the technical energy savings associated with various policies or programs.

Consumer impact analysis: which helps to estimate the probable energy savings associated with various policies or programs.

Program research: which offers insights into program design based on the implications of prior research.

These constructs are part of a systematic approach to policy formulation within the consumer/residential sector. The approach

attempts to avoid the ad hoc nature of many previous designs and emphasizes the utilization of prior research in establishing future policies.

PRIOR CONSUMER CONSERVATION PROGRAMS

While estimates vary by nation, it is generally recognized that sizeable energy savings can be achieved in the consumer/residential sector. Through retrofitting of existing housing stock the possible energy savings range from up to 50 percent in Canada and the United States to 15 percent in Great Britain and the Netherlands.[1] With improved vehicle efficiency energy savings exceeding 50 percent are possible in most Western nations.[2] These potential savings can make a significant contribution to reducing national energy demand. Under question is the degree to which this conservation potential has been captured.

There is little direct evidence concerning the contribution of consumer conservation activities to the decline in energy demand. The problem has been to partition the effects of consumer conservation actions from the effects of economic recession, a complex task. Virtually the only statements that can be made with any degress of accuracy are based on either total energy demand or petroleum based demand. For example, the "big seven" nations petroleum imports declined by 27 percent between 1979 and 1982.[3]

Interestingly, there is considerable information on the ineffectiveness of many government sponsored consumer energy conservation

policies and programs. To illustrate, mass advertising programs exhorting consumers to conserve energy are generally regarded as ineffective;[4] home audits have not proven to be cost-effective;[5] financial incentives in the form of tax credits do not accelerate consumer conservation actions;[6] and restrictions on energy use (e.g. - car-less days) have quickly been withdrawn from the market because of negative consumer reactions. The documented failure of many conservation policies and programs may be explained by inappropriate understanding of consumers vis-a-vis energy conservation and/or inappropriately designed policies and programs. Regardless, few, if any, effective national consumer conservation programs have been documented. Further, a review of the consumer energy conservation literature concluded:

> • A review of research dealing with conservation initiatives reveals no easy answers. Researchers have prodded consumers with direct-mail compaigns, telephone hot-lines, mass media advertising, appliance energy labels, consumption feedback, computerized home audits, time-of-day rates, and direct load controls. None of these studies have indicated substantial long-term savings.[7]

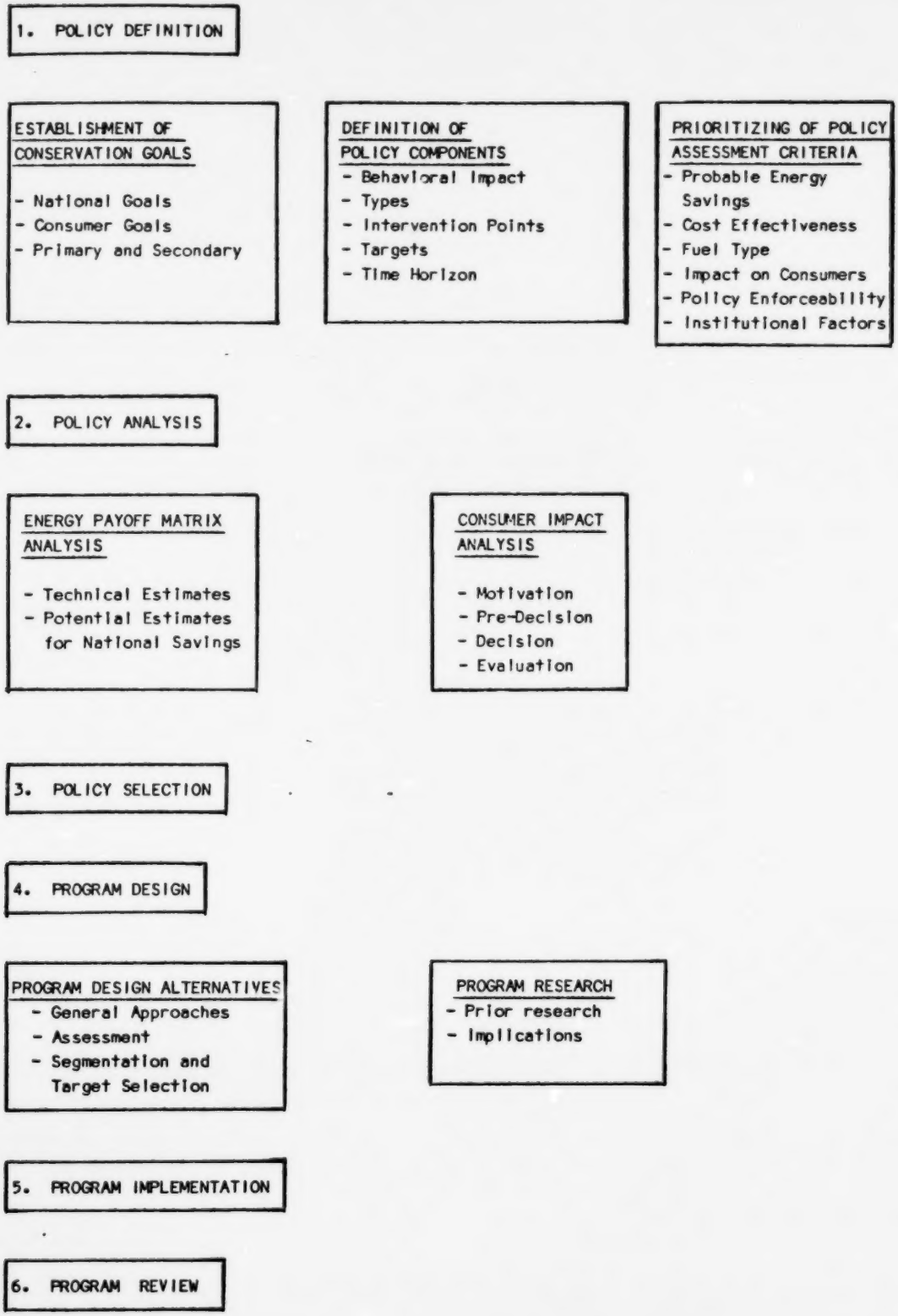
To avoid the pitfalls and problems which have arisen with past conservation programs, an analytic approach to policy formulation is recommended. This approach is described in the following sections of the paper.

THE POLICY FRAMEWORK

The policy framework (Figure 1) outlines the six major activities involved in establishing effective conservation programs. The primary

FIGURE 1

CONSUMER ENERGY POLICY FRAMEWORK



characteristic of this approach is its assumption of a rational and logical decision making process. It is recognized that this approach ignores the other major influences on government policy development; administrative, legislative, and political. In fact, it can probably be argued that these influences may have created some of the shortcomings in previous conservation programs.

POLICY DEFINITION

Establishment of Conservation Goals

Because of complexities in measuring both the supply and demand for energy by sector and by fuel type, national conservation goals frequently lack the precision necessary to set explicit targets for each sector. Instead, global goals are set (e.g. - a 5 percent reduction in oil imports in the forthcoming year) and efforts are made to reduce energy demand across sectors. The problem with this approach is that the potential savings by sector are seldom determined nor are the costs of achieving these savings calculated. Consequently, an accurate rank ordering of the benefit-cost ratios of various policies is not possible. While there is no easy solution to this problem it would seem appropriate to move towards the establishment of goals by sector and fuel-type.

Definition of Policy Components

Five separate components are viewed as defining overall energy policy. These components are:

Component 1 - Behavioral Impact: This element describes the intended impact on energy consuming behaviors. Some programs seek to enable consumers to perform on-going behaviors with greater energy efficiency. There are two types of efficient behavior; (1) operating efficiency where energy consuming products are kept in good order (e.g. - maintain furnace) and (2) investment efficiency where energy consuming products are modified (e.g. - add insulation to home) or replaced (e.g. - smaller car purchased). Stimulating vehicle tune-ups would be an example of an operating efficiency program, since it permits consumers to drive as many miles as in the past but still lower their gasoline consumption. Stimulating small car purchases would be an example of an investment efficiency program. In contrast, other programs are intended to foster curtailment of energy consuming behaviors. With respect to the example of driving behavior noted above, policies and programs designed to encourage or force a reduction in the annual average distance driven by consumers, would fall in this category. Finally, a third type of impact is referred to as demand shift. Examples of this class of initiative include efforts to shift consumers to an energy source that is more readily available and/or secure than the one they currently use (such as from oil to natural gas in Canada for heating) and programs to modify the timing of demand (such as those to reduce utility peak-load demand).

Component 2 - Classification of Conservation Policy Types: Two major dimensions are used to classify policy types. Dimension one

defines policy according to whether it involves financial or non-financial considerations. Dimension two defines the degree of coerciveness of a policy along a persuasive versus regulatory or mandatory spectrum. That is, policies can be one of four types:

-- a Voluntary/Non-financial program which provides information and advice on how to conserve energy,

-- a Voluntary/Financial program which offers tax and price incentives to encourage particular conservation measures,

-- a Mandatory/Non-financial program which restricts the availability of energy or energy-inefficient products,

-- a Mandatory/Financial program which imposes financial penalties on all consumers who refuse to conform to regulations or laws governing energy usage.

Clearly, from a political and a philosophical viewpoint, voluntary policies are preferable. However, the success of these types of policies is dependent upon the support and participation of the majority of the population. Policy makers assessing and choosing options from the matrix must continually make trade-offs between the effectiveness and social acceptability of the available alternatives. For example, policy makers might want to examine the programs that could be generated using the policy types and the behavioral impact dimension to assess the probable consumer acceptance of the measures. Further, it should be emphasized that <u>combinations</u> of these policies may be the most effective route in achieving conservation goals.

<u>Component 3 - Point of Intervention</u>: In this regard three major intervention points can be defined:

1. interventions which focus on the availability of particular energy consuming products or certain inefficient forms of certain products (e.g., appliances, automobiles)

2. interventions which attempt to influence the consumer decision process in order to encourage the purchase of the most efficient products and services currently available in the marketplace.

3. interventions which aim at the usage behavior of consumers with respect to products they possess. The objective of such interventions may in turn be designed to encourage:

   a) cutbacks in the level of usage of these products,
   b) more efficient operation of the products,
   c) greater efficiency through improved maintenance of the products.

In practical terms, policies and programs intended to affect product/service availability are most commonly oriented towards the manufacturer, and to a lesser degree, towards the retailer. Interventions directed towards influencing consumer purchase decisions normally operate at two levels; that of the retailer by means of point of purchase information as well as education of sales personnel, and that of the consumer through information, education and incentive programs. Finally, actions to modify usage behavior must by definition be focused on consumers with a broad range of approaches being possible. In addition, programs can be generated by combining the type of policy and the point of intervention. By combining these policy components, sharper and more focused conservation programs can be established.

Component 4 - Functional Target of Energy Conservation Policies: From a policy implementation standpoint, as well as from a number of practical considerations of program design, it is frequently desirable

to distinguish among several functional targets of conservation policies. The term "functional target" refers to the general nature of the tasks for which energy is being consumed (e.g. - household heating and cooling, transportation). As with the previous illustration, the policy components assist in guiding planners through a wide variety of alternatives in a systematic manner.

Component 5 - Time Horizon of Policy: Consumer demand for energy is relatively inelastic in the short run due to the rigidities imposed by the time required to replace the existing stock of energy consuming equipment. This observation points out the need for policy-makers concerned with energy conservation to develop a set of strategies and programs which take into account the difficulties in undoing the energy inefficient decisions of the past.

In the short term policies (1-3 years) must of necessity take as a given the existing housing and transportation stock. As such, energy conservation programs designed for this time frame will focus on modifying the usage of existing facilities and products. Some attention may also be directed towards minor retrofitting activities designed to improve the efficiency of the existing stock. Medium term policies (4-10 years) offer greater opportunities for substantial energy savings. Within this time frame it is possible to significantly alter the energy efficiency of most products through the shifting of standards at the manufacturing level and the imposition of disincentives at the consumer level. Some progress may also be possible in bringing

about meaningful changes in work and lifestyles which will result in energy savings. For example, the acceptance of flexible working hours could improve the energy efficiency of the total system of commuting currently in place.

Major changes in the way society works and lives which will substantially reduce total energy requirements fall into the category of long term policy (10 years or more). Here, reference is being made to efforts to restructure such major items as existing work patterns, neighborhood design and leisure lifestyles. While to date, energy research and conservation efforts have focused on the more manageable short and medium term dimensions of policy, there is a need to start debating the elements of a systematic effort to capture the more dramatic energy saving possibilities over the longer term.

Prioritizing of Policy Assessment Criteria

The third element of the policy definition stage involves the establishment of the relative priorities which are to be accorded to the evaluation criteria used to judge the success or failure of the total conservation effort. Stated differently, what criteria are the most appropriate indicators as to whether a particular policy can be judged successful or unsuccessful? These policy criteria are perhaps broader in scope than would be supposed at a first glance, particularly as they pertain to democratic Western societies in a non-crisis period. Within this framework, at least six criteria appear relevant:

1. Probable Energy Savings: Clearly, a major criterion in selecting energy conservation policies must be the energy savings. The intention here is to recognize that probable energy savings represent a net impact based on potential savings in a technical sense, reduced to allow for imperfect behavioral response. For example, the potential energy savings to be realized by all households reducing their thermostat settings from 21°C to 19°C might be 4 percent of total in-home energy consumption. However, a particular program might be expected to influence only 25 percent of all households, so that probable energy savings would be only 1 percent.

2. Cost Effectiveness: A second criterion to be considered is the cost of achieving a given level of energy savings. Cost effectiveness requires the evaluation of the efficiency of alternative programs. For example, should a new program attempt to influence all households, or target on a particular heating user group? Should consumers be informed about a new program through utilities, retailers or mass media? Delivery approach questions such as these are clearly of concern to those who must choose from the available alternatives.

3. Impact by Fuel Type: For many Western nations the current energy problem is mainly a petroleum problem. In this context, it is therefore appropriate to explicitly assess the success or failure of consumer energy policy in relation to its impact in reducing petroleum consumption as well as in reducing total energy demand. In fact, the

attainment of oil substitution goals may be judged more important in the short run that the reduction of overall energy consumption.

4. The Impact on Consumers: Alternative policies to meet conservation objectives could have substantially different impacts on consumers. On an overall basis, what is of most concern to policy makers is the level of acceptability of alternative policies by consumers. At least three factors can be considered to exert a significant influence on consumer acceptability. These are the extent to which the policy: 1) reduces consumer choice, 2) causes inconvenience to consumers, and 3) impacts equitably across all groups of consumers. From a policy formulation standpoint, it is clear that actions which do not reduce consumer choice substantially, which cause little inconvenience, and whose impacts are perceived to be fairly distributed throughout the population will gain greater acceptance than actions which violate these criteria.

5. The Enforceability of the Policy: Even the most promising energy policy will prove of relatively little value if it is difficult to enforce or if the costs of enforcement are unduly high. Indeed, evidence indicates that consumers, when asked to rate the acceptability of various policy alternatives, tend to be favorably disposed towards actions which do not appear particularly attractive simply because they feel such policies cannot be effectively enforced.[8]

Policy makers attempting to formulate consumer energy policy must make some initial judgments concerning the relative priorities which they attach to each of the above criteria and the extent to which they are willing to make trade-offs among them. For example, judgments must be made concerning the extent to which the impact on consumers will be allowed to constrain actions which would clearly result in energy savings. Existing research findings have the potential to provide considerable guidance for making such decisions. To be useful however, these findings and their implications, must be organized and interpreted in a practical manner.

6. Institutional Considerations: This criterion refers to the problems or barriers that may impede the implementation of a policy. In one review of the Canadian situation four major obstacles to energy conservation policy formulation and implementation were identified.[9] They were federal-provincial relations, intra-departmental organization, inter-departmental overlap, and lack of government-industry cooperation.[9]

POLICY ANALYSIS

Once the parameters defining the content of energy policies have been formalized, it becomes possible to employ this framework as the basis for assessing the probable impact of a range of policy options described by these parameters. The goal of conducting such an impact

analysis is to estimate, primarily through research evidence, the success which is likely to be achieved from alternative policies.

The framework described in Figure 1 identifies two distinct and essential types of analyses which must be carried out. These are the Energy Payoff Matrix Analysis and Consumer Impact Analysis.

Energy Payoff Matrix Analysis

In the discussion pertaining to criteria for evaluating consumer energy policies, it was stressed that potential and probable energy savings must be a primary consideration when choosing among alternative approaches. While conceptually straightforward, it is necessary to operationalize the choice criterion if it is to be useful. The mechanism for doing so is referred to as a "Pay-Off Matrix". One example is given in Table 1 which uses the policy component dimensions of target and behavioral impact. Such a matrix attempts to quantify the energy savings that are likely to result from various conservation programs appropriate to different energy use targets. By consolidating information in a pay-off matrix, it is possible to readily identify those areas where conservation efforts may make a significant contribution to reducing energy consumption. Then, when combined with information on cost and ease of implementation, this information provides a basis for defining priorities for consumer energy policy.

The payoff matrix provides critical baseline data for potential savings in the consumer sector. It is a general concept that identifies

TABLE 1

Estimated Household Energy Savings Through Conservation Activities[a]
(Percentage of Household Consumption)

Target	Efficiency Operating	%	Investment	%	Curtailment	%	Demand Shift[b]	%
Appliances	Clean oven regularly	.05	Purchase energy efficient refrigerator	3	Dry clothes on line, not in dryer	1	Convert electric appliances to natural gas	n.a.
Heating	Change filters on furnace twice a year	4	Insulate and weatherize home	30	Set back thermostat to 20°C days and 18°C nights	4	Install solar panels to heat home	n.a.
Cooling	Regular air conditioner maintenance	2	Purchase energy efficient air conditioner	4	Set air conditioner at 24°C during day	2	n.a.	n.a.
Water Heater	Regular heater maintenance	3	Purchase more efficient unit	6	Set back thermostat by 10°C	2	Install solar panels to heat water	n.a.

[a] Estimates obtained from various sources including C.W. Cullen, The Potential for Energy Conservation in the Residential Sector, Unpublished Report, Consumer and Corporate Affairs, Canada, Ottawa, Canada, 1979, and G.H.G. McDougall et al., "Consumer Energy Research: A Review," Journal of Consumer Research, Vol. 8, No. 3, December 1981, pp. 343-354.

[b] Estimates for "demand shift" do not appear to have been documented.

the points of greatest impact. Further, it can be used in conjunction with each of the policy components and assessment criteria to provide estimates of the greatest returns in terms of energy savings from a particular policy. It can be applied to the policy components separately or in combination to assess the returns and guide policy.

The importance of the energy payoff matrix in combination with the policy components can not be understated. It is the fundamental approach to providing a logical consistent process for policy making and program development in the consumer energy conservation field.

To summarize, the development and regular updating of both overall and detailed sector payoff matrices is an essential component of an effective process for the formulation of consumer energy policy. Without current realistic estimates of the potential for energy conservation across various sectors of the economy, it is extremely difficult to establish priority targets for future efforts.

Consumer Impact Analysis

The second major type of analysis required to develop conservation policy is termed "Consumer Impact Analysis". This form of analysis provides policy makers with an in-depth understanding of fundamental cognitive and behavioral processes which underlie the manner in which consumers perceive and respond to various types of conservation initiatives. The analysis can be structured around a simple consumer decision making framework which has four components: motivation, pre-decision activity, the decision and post-decision

evaluation. By understanding the process consumers may follow in deciding whether to engage in conservation activities, policy-makers can determine at what points or steps in the process that programs are likely to have the greatest impact. The inputs to such analyses are primarily derived from the increasing number of basic research studies which have been reported in the literature.

While space limitations prevent a detailed discussion of the policy implications resulting from a review of the basic research studies, a few examples will be offered to show the insights provided by one "consumer impact analysis":[10]

- conservation programs which are based on motivating people by means of nationalistic or altruistic goals will have either no impact, or under extraordinary circumstances, minimal impact.
- conservation programs which use information to outline the financial benefits of specific conservation activities will be of interest to consumers. Whether people will be motivated to act will depend on the perceived benefits they feel they will derive from the activity.
- There are a selected number of curtailment behaviors which have a relatively low impact on lifestyle. Conservation programs focused on these behaviors may be successful.
- Because most curtailment behaviors require continuous action (e.g. - continuous lower thermostat settings), people may need to be reminded to keep engaging in the behavior until it becomes habitual.
- consumers may not decide to take conservation actions even when it is in their economic self-interest to do so. The reason is that there are a number of barriers to conservation which prevent the decision from occurring. The major barriers for each of the three types of conservation behaviors include, habit and inertia (curtailment), forgetting (maintenance) and monetary investment (efficiency).

programs must consider consumers' reaction to low energy savings. If consumer expectation levels are high and are not matched by appropriate savings (energy and money) they will stop the behavior.

- if consumer expectations are met, they will continue the behavior and they may engage in more energy conserving behaviors.

In summary, consumer impact analysis provides the policy maker with a basic understanding of the possible behavioral reactions to various energy conservation approaches. At a minimum, a review of this type of research will "sensitize" the policy maker to the major issue to be faced in attempting to translate potential energy savings into probable energy savings. However, if used properly, such research can provide much more. It can indicate what areas are worthy of further detailed research; it can suggest the nature and thrust of the most appropriate policies in these areas; and it can aid in anticipating the implementation problems likely to arise for the approach which is ultimately chosen.

POLICY SELECTION

Policy selection represents the ultimate judgment of policy makers concerning which areas should be accorded priority for conservation efforts and which overall strategies are most likely to succeed within each of the chosen areas. The Energy Payoff Matrix analysis gives direction for the first set of decisions while Consumer Impact Analysis provides guidance for the second set. While conceptually simple and of relatively short duration, Policy Selection is critical because it

defines the scope and direction of the detailed program decisions which follow.

PROGRAM DESIGN

Within the framework employed here, the operational design of specific consumer conservation programs is viewed as drawing on two main sources of ideas and inputs. The first source, termed Program Design Alternatives, provides managers with a number of basic concepts which can be used to define a range of possible program initiatives. The second, Program Research, provides managers with the knowledge gained as the result of experience with various conservation initiatives that have been tried by others in the past.

Program Design Alternatives

The design of consumer conservation programs involves two levels of planning. Initially there is a need for broad strategic planning in which general policy guidelines arrived at earlier in the process are translated into specific program characteristics. Subsequently, these strategic program characteristics must be further translated into detailed operational plans for program implementation. While this latter, more detailed, process is beyond the scope of this paper, it is felt useful to briefly comment on some considerations at this strategic level of program planning and design.

The promotion and/or acceleration of energy conservation resembles in many ways a traditional marketing problem, although there are

some very unique factors involved. With this in mind, the following concepts related to consumer decision making, consumer benefits, segmentation and target selection and marketing strategy are relevant in considering program design alternatives.[11]

Program Research

As with consumer impact analysis, program research relies heavily on reviewing prior consumer energy research. This is potentially a considerable undertaking as in excess of 900 studies have been conducted in the area.[12] As a first step, the review can be organized as the research, in general, has centred on five major areas: (1) information, such as pamphlets enclosed in utility bills, advertising campaigns, house efficiency evaluations done by professional auditors, and appliance energy-consumption labels, (2) incentives, such as grants for purchase of insulation, tax credits for installation of solar equipment, and low interest loans for the purchase of heat pumps, (3) disincentives, such as gasoline taxes, surcharge on energy inefficient automobiles, and price rates that penalize consumption during peak periods, (4) standards, such as product energy efficiency standards, and (5) restrictions, such as eliminating the use of automobiles on specified days, and devices on home air conditioners that allow direct control by the electrical utility.

To provide some idea of the implications that can be drawn from this type of review the following comments are offered:[13]

- mass advertising programs have had little success because (1) they frequently have been directed at curtailment behaviors (asking consumers to use less), (2) they have not been supported by other programs showing consumers how they can save energy, and (3) they have seldom provided the consumer with relevant reasons or incentives to save energy.

- Home audit programs have had little or not impact because (1) consumers may view the information with some skepticism because of the potential measurement inaccuracies, (2) the information, in the form of recommendations to retrofit, may be insufficient to stimulate action, and (3) there are several important barriers which impede action by homeowners with respect to audits that have not yet been adequately overcome.

- financial incentives can accelerate consumer conservation practices, but the problem is to identify the most cost-effective means of implementing financial incentives.

- increasing energy prices will encourage conservation because it is in the economic self-interest of consumers to become more energy efficient.

In conclusion, the program research review provides the policy maker with the results of previous conservation programs. These results should be evaluated in terms of reliability and validity and their applicability to the policy makers particular situation. In many cases the review should offer the policy maker an idea of the reasons why previous programs were not successful. As well, the review should offer some insights for design features for new programs.

PROGRAM IMPLEMENTATION

Policy formulation and program design are only a prelude to actions designed to achieve energy conservation objectives. Obviously, policies and programs, no matter how well formulated, will prove ineffective unless they are translated into real world activities which

bring about the desired behaviors and energy savings. While an extensive discussion of the problems and issues involved in the implementation of consumer energy conservation programs is beyond the scope of this paper, one key point must be kept in mind when undertaking program implementation. This point concerns the strong and pervasive nature of the resistance to change in behavioral patterns which have been developed over extensive periods of time. Indeed, much energy use behavior has become an integral part, or is the product of, the culture in which consumers live. Programs to change energy use behavior, no matter how well designed, must anticipate the strength of consumer resistance to substituting one type of behavior or product for another, particularly when the new may be judged substantially less attractive than the old. Viewed in this light, the implementation of consumer energy conservation programs must be undertaken with a firm resolve while maintaining the ability to adapt to changing and unforeseen circumstances.

PROGRAM REVIEW

If conservation programs are to be most effective, it is essential that their impact be continuously monitored in order to determine which types of initiatives are proving most successful and most acceptable to consumers. This will enable appropriate program modification to take place as early as possible and before the program becomes discredited in the eyes of the energy consumer. As is repeatedly pointed out in virtually all the literature dealing with

program evaluation, it is important that this review be an integral part of the total policy formulation and program management process and that it be initiated at a very early stage in the process.

To date, there has been relatively little attention paid in the literature to formal program review, although this situation is now changing rapidly.

CONCLUSION

It would be unfortunate if the recent decline in energy demand created a false sense of security concerning the future of petroleum supplies. These events provide an opportunity to implement effective conservation programs to ensure economic stability. Significant conservation gains can be achieved in the consumer sector with programs that are based on an analytic approach to the problem.

Fundamental to this approach are some key notions including the identification of the available options through a definition of policy components and an assessment of the options to establish priorities. As well, a technical analysis of the savings associated with the options coupled with a determination of the probable consumer response should lead to a selection of viable programs. The design and implementation of these programs can be enhanced by reviewing prior initiatives in the area. The results of this analytic approach--economic stability and energy security--are goals well worth pursuing.

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ABSTRACT

To capture the potential energy savings available in the consumer sector an analytical approach to conservation policy is proposed. A policy framework is described and the key constructs including a pay-off matrix analysis and a consumer impact analysis are discussed. Implications derived from the considerable amount of prior consumer research are provided to illustrate the effect on the design and implementation of future programs. The results of this analytic approach to conservation policy - economic stability and economic security - are goals well worth pursuing.